Running Title: Four *Rosa* Species Section *Caninae* from Tunisia Characterised by Their Rose Hips

Pomological Description and Chemical Composition of Rose Hips Gathered on Four *Rosa* Species Section *Caninae* Growing Wild in Tunisia

Zohra Ben Cheikh-Affene*[1], Faouzi Haouala[2], Najla Trabelsi[3], Monther Boulaaba[3], Riadh Ksouri[3], Fethia Harzallah-Skhiri[4]

[1]Corresponding author, Department of Horticultural Science and Landscape, Higher Agronomic Institute University of Sousse, 4042 Chott Mariem, Sousse, Tunisia
[2]Department of Agronomy and Plant Biotechnology, National Agronomic Institute of Tunisia, University of Carthage, 43 avenue Charles Nicolle, 1082 Tunis Mahrajène, Tunisia
[3]Laboratory of Extremophiles Plants, Center of Biotechnology, Ecopark of Borj Cedria (CBBC), BP 901, 2050 Hammam–Lif, Tunisia
[4]Laboratory of Genetic, Biodiversity and Valorisation of Bioresources (LR11SE14), Higher Institute of Biotechnology of Monastir, University of Monastir, Rue Tahar Haddad, 5000 Monastir, Tunisia

[1]ben-chiekh.zohra@laposte.net; [2] faouzi.haouala@laposte.net; [4] fethiaprosopis @yahoo.fr

Abstract

This study was carried out to determine pomological and chemical characteristics of rose hips from four *Rosa* species belonging to *Caninae* section growing wild in the North and the Centre of Tunisia. Fourteen parameters related to pomological and chemical characteristics were recorded. Mean rose hip weight ranged from 0.9±0.2 to 1.9±0.3 g, the height from 15.1±1.8 to 18.9±1.6 mm and the width from 10.5±0.7 to 14.1±0.8 mm. The vitamin C, carotenoid and total polyphenol contents varied between 372.4±4.7 and 737.8±10.6 mg/100 g fresh weight (F.W.), 206.4±4.0-667.5±9.7 μg. g^{-1} F.W., 25.2±3.0-69.6±2.1 mg gallic acid per gram of dry weight (D.W.), respectively. The result of the present study showed a large morphological variation among rose hips of the Tunisian rose species of section *Caninae* and a high content in bioactive substances. The phenotypic divergent genotypes identified in this study would be of much utilization in future breeding programs.

Keywords

Ascorbic Acid; Carotenoïds; Polyphenols; Pomological Parameters; Principal Components Analysis; Rosa

Introduction

Roses, one of the most popular groups of ornamental plants, have enjoyed much reputation since antiquity. A large number of cultivars have been developed either as gardening plants, or for the rose market or as indoor pot plant. They have been grown also for production of rose oil and rose water as well as for cosmetic and medicinal purposes (Warholm *et al.*, 2003). The genus *Rosa (Rosaceae* family) includes about 200 species subdivided into 10 Sections (Rehder, 1940) dispersed in the temperate and subtropical zones of the Northern hemisphere. The sections *Caninae* and *Cinnamomeae*, the largest ones, include about 50 and 80 species, respectively (Wisseman, 2003). *Rosa* species produce rose hips, a pseudocarp or a false fruit, consisting of a fleshy wall surrounding achenes with one seed.

Rose hips of some species, especially *Rosa canina* (dog rose) (Section *Caninae*) are used in many countries as raw material in different products such as jam, juice, tea and syrup. In Sweden, in the mid-eighties, a program for domestication of wild roses (Section *Caninae*) for rose hips production was initiated in Balsgård and in 1993, about 130 hectares of dog roses have been established (Uggla and Martinsson, 2005). As well, in Chile, since 1991, an annual average amount of 6800 metric tons of dried fruit flesh has been exported to the European countries, mainly Germany (Joublan and Rios, 2005).

Interest in utilization of rose hips is slowly growing, and research is now conducted on the role of these

fruits in human nutrition. The fresh rose hips are the richest fruits in terms of vitamin C (Uggla and Martinsson, 2005) and valuable because of their high antioxidant capacity and the high amount of carotenoid and phenolic compounds (Gao *et al.,* 2005). Recent clinical studies have shown that dried rose hips induced a reduction in symptoms in patients previously diagnosed with osteoarthritis (Warholm *et al.,* 2003). Also anti-inflammatory (Winther *et al.,* 1999), anti-ulcerogenic (Gürbüz *et al.,* 2003) and anti-mutagenic (Karakaya and Kavas, 1999) activities have been demonstrated.

Within Tunisian flora, there are known 10 spontaneous species and subspecies of roses (Le Floc'h, Boulos and Vella, 2010) growing wild in ravines, with bushes, and in the forests from the North to the Tunisian Dorsal (Pottier-Alapetite, 1979). This study was designed to explore Tunisian wild rose populations belonging to *Caninae* section, in which rose hips were known for their high value for bioactive substances (Gao *et al.,* 2005), to describe and characterize their false fruits in the aim to select the most promising rose accessions for future breeding efforts or for their use in medicinal or food field.

Materials and Methods

Plant Material

Rosa genotypes from the section *Caninae* were collected from altitudes between 228-942 m from the North, the Northeast, the Centre and the South of the Tunisian dorsal area. According to taxonomic criteria (Bailey, 1963) four species were identified i.e.; *Rosa canina* L. from Zaghouan region, *R. pomifera* L. and *R. rubiginosa* L. from Kairouan region, *R. dumetorum* Thuiller and *R. rubiginosa* L. from Beja region and *R. dumetorum* from Seliana region. All accessions are upright shrubs with thorny branches.

All voucher specimens are deposited in the Higher Institute of Agronomy of Chott-Meriem, Horticultural Laboratory Herbarium and were assigned for each one a corresponding number (codes RR110-RR115).

The rose hips were harvested at the fully ripe mature stage (late September and October 2007). Flesh part was extracted from 500g of other rose hips, mixed in a mortar with liquid nitrogen, and the half of the tissue was stored at 4°C until the analysis of ascorbic acid and carotenoids. The other part was lyophilized and stored at 8°C until the analysis for total phenols (Table 1).

Parameters Studied

1) Biometrical Characteristics

Thirty rose hips were randomly chosen for each accession and used to measure the pomological parameters. It was also noted that personally we enjoyed the aroma of rose hips (qualitative and quantitative parameters) (Table 1).

2) Determination of Ascorbic Acid Content

Free ascorbic acid was extracted from 0.2 mg of the frozen flesh tissue mixed with 0.8 ml of frozen trichloroacetic acid (6%). The mixture was centrifuged at 15,600 g (4°C) for 5 min, and the upper layer (0.2 ml) was placed on ice and mixed with 0.2 ml of dithiothreitol (10 mM), 0.4 ml of buffer phosphate (pH 7.4) and 0.2 ml of N-ethylmaleimide (0.5%). The mixture was incubated for 15 min at 42°C in darkness. After that, 1 ml of trichloroacetic acid (10%), 0.8 ml of phosphoric acid (42%), 0.8 ml of 2.2 dipycridyl (4%) and 0.4 ml of ferric chloride (3%) were added, then shaken vigorously and kept at room temperature 42°C for 40 min. Absorbance of the solution was then measured spectrophotometrically at 525 nm (model Anthelie Advanced II, Secomam) according to Kampfenkel *et al.,* (1995) with some modifications. Analyses were conducted in triplicates. The concentration of total ascorbic acid content was calculated using a standard curve. Results were expressed as mg of ascorbic acid per 100 g fresh weight (F.W.).

3) Determination of Carotenoïd Content

Flesh frozen tissue (0.2 mg) was homogenised 24 h with 200 ml of acetone 80% (v/v). After incubation at ambient temperature during 3 days, the mixture was centrifuged at 14,000 g for 5 min. The absorbance of the extract was measured at 470 (A_{470}), 647 (A_{647}) and 663 nm (A_{663}) using a spectrophotometer according to Nonier *et al.,* (2004). Contents of total carotenoïds were calculated according to the following equation: total carotenoïds ($\mu g.ml^{-1}$) = [(5*A_{470}) + (2.846*A_{663}) – (14.876*A_{647})]. Analyses were run in triplicates. Total carotenoïd content was expressed as μg carotene per g fresh weight.

4) Assay of Total Phenol Contents

Lyophilised fruit tissue (1 g) was extracted by stirring with 10 ml of absolute methanol at room temperature for 30 min. Extracts were kept for 24 h

at +4°C, and then filtered through Whatman filter paper. Extracts were evaporated under vacuum to dryness and stored at +4°C until analysis. The content of total polyphenols was measured according to the method of Dewanto *et al.,* (2002) using Folin-Ciocalteu reagent. 25 µL of suitable diluted sample extract was dissolved in 500 µL of distilled water and 125 µL of the Folin-Ciocalteu reagent. The mixture was shaken, before the adding of 1250 µL Na_2CO_3 (7%), adjustment with distilled water to a final volume of 3 mL, and mixed thoroughly. After incubation for 90 min at 23°C in darkness, the absorbance versus a prepared blank was read at 760 nm. A standard curve of gallic acid was used. Total polyphenols content of the flesh was expressed as mg gallic acid equivalent per gram of dry weight (mg GAE.g^{-1} D.W.) through the calibration curve with gallic acid. The calibration curve range was 0-400 µg mL^{-1} (R^2 = 0.99). All samples were analyzed in three replications.

Statistics Analysis

A two-way analysis of variance (ANOVA) and Duncan's multiple range test were carried out to investigate any significant differences between parameters at $p < 0.05$. All the data were subjected to Principal Components Analysis (PCA) (Cottin, 1988) using the SPSS 16 software (Statistical Package for the Social Science) (Inc. Chicago, IL, USA) and Excel 2007 softwares, allowing the classification of *Rosa* genotypes into similar groups. Correlation between pomological and chemical parameters was calculated using Pearson coefficient.

Results and Discussion

Biometrical Characteristics

The dimension of the rose hips varied in the height range of 15.1±1.8 - 18.9±1.6 mm, from *R. rubiginosa* Beja region to *R. pomifera* Kairouan region and the width between 10.5±0.7 - 14.1±0.8 mm from region *R. dumetorum* Beja region to *R. rubiginosa* Kairouan (Table 2). *R. rubiginosa* Kairouan region has the heaviest rose hip (Rh.W.) and flesh fruit weights (Fl.F.W.) (Rh.W. = 1.9±0.3 g; Fl.F.W. = 1.2±0.2 g) and a medium flesh rose hip ratio (Fl/Rh. = 65.4±4.0%). *R. canina* Zaghouan region has the highest flesh rose hip ratio (Fl/Rh. = 73.7±8.2%) and the highest dry weight of flesh (Fl.D.W. = 0.40±0.08 g). The achene number (A.Nb) varied in a range of 6.1±3.0-18.6±3.5, from *R. pomifera* Kairouan region to *R. canina* Zaghouan region and achene weight (A.W.) varied between 0.016±0.001-0.034±0.001 g from *R. dumetorum* Seliana region to *R. rubiginosa* Kairouan region. *R. canina* Zaghouan region has high achene weight (0.033±0.002 g) but the lowest achene number (6.1±3.0).

It was also noted that when the flesh fresh weight (Fl.F.W.) was as lower as the rose hip weight (Rh.W.), the highest ratio (Fl/Rh) and a moderate number of achenes were gained as for the two *R. dumetorum* accessions and for *R. canina*. Nevertheless, when the flesh fresh weight was at least 1.5 time than Rh.W., the ratio was moderately important as for *R. pomifera* and the two *R. rubiginosa* accessions and the number of achenes was the highest.

TABLE 1 POMOLOGICAL AND CHEMICAL PARAMETERS, CODES AND UNIT

N	Parameters	Code	Unit
	Quantitative parameters		
1	Rose hip height	Rh.H	mm
2	Rose hip width	Rh.Wi	mm
3	Rose hip weight	Rh.W	g
4	Flesh fresh weight	Fl .F.W	g
5	Flesh rose hip ratio (based on F.W.).	Fl/Rh	-
6	Flesh dry weight	Fl.D.W	g
7	Moisture content in flesh	Mo	%
8	Achene number	A.Nb	-
9	Achene weight	A.W	g
10	Total polyphenol in flesh	T.po	mg GAE.g^{-1} D.W.
11	Total ascorbic acid in flesh	As.A	mg/100 g F.W.
12	Total carotenoid in flesh	Car	µg.g^{-1} F.W.
	Qualitative parameters		
13	Rose hip color (dark red 1; red 2; scarlet orange 3)	Rh.C	(1,2,3)
14	Fruit aroma (good 1; medium 2)	Rh.A	(1,2)

*GAE/Gallic Acid Equivalent

TABLE 2 POMOLOGICAL CHARACTERISTICS OF ROSE HIPS FROM THE SIX *ROSA* ACCESSIONS

Parameters	*R. pomifera* Kairouan	*R. rubiginosa* Kairouan	*R. rubiginosa* Beja	*R. dumetorum* Beja	*R. dumetorum* Seliana	*R. canina* Zaghouan
*Rh.H (mm)	18.9 ± 1.6d*	17.7± 1.5 c	15.1± 1.8 a	16.9±1.8bc	16.8± 1.8 bc	16.1±1.1 b
Rh.Wi (mm)	11.7±1.1 b	14.1± 0.8 d	12.3±1.1 c	10.5±0.7a	10.5± 0.8 a3	10.8± 0.7 a
Rh.W. (g)	1.4±0.3 c	1.9±0.3d	1.2±0.3 b	0.9±0.2a	0.9±0.2 a	1.0±0.17 a
Fl.F.W.(g)	0.9±0.2 b	1.2±0.19c	0.79± 0.2 a	0.7±0.15 a	0.69±0.15 a	0.77±0.1 a
Fl/Rh	63.6± 3.2 a	65.4±4 a	66.3± 6.0 a	72.0±3.8 b	72.0± 3.8 b	73.7±8.2 c
Fl.D.W. (g)	0.37±0.07 bc	0.39±0.07 c	0.30± 0.1 a	0.30±0.06 a	0.30±0.06 a	0.40± 0.08 c
Mo. (%)	59.3±4.7c	69.1±7.4 d	57.2±4.5bc	54.1±6.5 b	54.1±6.5b	47.1±5.6 a
A.Nb	18.6±3.5 d	14.2± 2.9 c	13.4± 4.6 c	10.8± 3.2 b	10.8± 3.2 b	6.1± 3.0 a
A.W. (g)	0.020±0.001b	0.034±0.001e	0.026±0.001d	0.023±0.001c	0.016±0.001a	0.033±0.002e
Rh.C	Dark red	Dark red	Dark red	Scarlet orange	Scarlet orange	Red
Rh.A	Good	Good	Good	Medium	Medium	Medium

* For Abbreviation See Table 1. means±SD (n=30). Values with the Same Letter were not Different at $p < 0.05$

Rose hip color varied from dark red (*R. pomifera* Kairouan region and *R. rubiginosa* Kairouan and Beja regions) to red (*R. canina* Zaghouan region) and to scarlet-orange (*R. dumetorum* Beja and Seliana regions). Rose hips of *R. pomifera* Kairouan region and *R. rubiginosa* Kairouan and Beja regions have a good aroma (Table 2).

Similarly, studies in pomological description of various *Caninae* species from different regions of Turkey showed a great variability. In fact, Kasankaya *et al.,* (2005) reported that rose hip weight ranged between 2.0 and 5.8 g which greatly exceeded the values found in our analysis. The Fl/Rh. ratio of the Tunisian genotypes was in general in the limits of previous studies (63.6±3.2-73.7±8.2%). Indeed, in the work of Celik *et al.,* (2009) the proportion of flesh for rose hips varied between 46.7-86.6%, in contrary, the number of achene by hip was higher than our results and varied between 18 and 41.

In some of the previous studies conducted in Turkey, it was demonstrated that the flesh rose hip ratio can also vary depending on species and that the differences in ecological conditions and cultural practices are important factors affecting flesh rose hip ratio. Particularly, irrigation caused a significant increase in rose hip weight and flesh rate (Günes, 2010). In fact, for the same species *R. rubiginosa*, great differences have been reported between the accession from Kairouan region and that from Beja region, two localities with very different soil and ecological conditions.

Total Ascorbic Acid Content

Total ascorbic acid contents varied with rose accessions. The highest total content of ascorbic acid was found for *R. pomifera* (737.8±10.6 mg/100 g F.W.). Nevertheless, rose hips from *R. rubiginosa* Beja region showed also a high value for this acid; 545.0±13.9 mg/100 g F.W. (Table 3). The lowest values were assayed in *R. rubiginosa* Kairouan region and *R. dumetorum* Seliana region (384.0±11.9 and 372.4±4.7 mg/100 g F.W., respectively).

In previous comparative studies, a great variability in vitamin C content of rose hips was also found. Kazankaya *et al.,* (2005) found that the ascorbic acid content of various species of *Rosa* section *Caninae* from different regions of Turkey ranged between 301 and 1183 mg/100 g F.W. Demir and Özcan (2001) found a content of 2712 mg/100 g F.W. in *R. canina* rose hips.

Based on comparison of the amount of ascorbic acid of Tunisian dog roses and other *Rosaceae* species known for their high content of vitamin C, it is indicated that the amount of ascorbic acid in fruits of wild roses was higher than that in blackberry, (*Rubus caesius* L.) (33.85 mg/100 g F.W.) blackthorn (*Prunus spinosa* L.) (21.94 mg/100 g F.W.), rowan (*Sorbus aucuparia* L.) (68.18 mg/100 g F.W.) and wild strawberry (*Fragaria vesca* L.) (80.84 mg/100 g F.W) growing wild in Poland (Jablonska-Rys *et al.,* 2009). As well, this amount is much higher than that for Tunisian *Crataegus azarolus* genotypes (35.9 mg/100 g) (Bahri-Sahloul *et al.,* 2009). The content of vitamin C is determined by numerous factors, including species, variety, cultivation, climate, wheather conditions, ripeness, region and storage time (Pantelidis *et al.,* 2007). Günes (2010) mentioned that the variation in vitamin C content was clearly related to genotypes.

Total Carotenoid Content

Total carotenoid content varied more than three fold, in the range of 206.4±4.0 and 667.5±9.7 μg.g^{-1} F.W. *Rosa pomifera* rose hips have the highest content and those from *R. canina* the lowest (Table 3). A high content was found by Olsson *et al.,* (2005) (1192 μg.g^{-1} F.W.) in *R. dumalis* Bechst. from Sweden. According to our results, the total carotenoïds in rose hips are much better than that in carrot (95.08 μg.g^{-1} F.W.), papaya (46.38 μg.g^{-1} F.W.), guava (42.58 μg.g^{-1} F.W.) and tomato (32.81 μg.g^{-1} F.W.) (Mélo *et al.,* 2006). Razungles *et al.,* (1989) reported in their study that rose hips contained the highest concentration of total carotenoids compared to black chokeberry (*Aronia melanocarpa* Michx.).

Total Polyphenol Content

The variation in total polyphenol contents was relatively low with values ranging from 25.2±3.0 to 69.6±2.1 mg GAE.g^{-1} D.W. (Table 3). *R. pomifera* has the highest content whereas *R. rubiginosa* and *R. dumetorum* from Beja region have the lowest content.

The literature mentioned a great variability in total polyphenol contents of rose hips. Barros *et al.,* (2010) found a content of 143.1 mg GAE.g^{-1} D.W. in *R. canina*. A moderate content was observed in *R. dumalis* (84 mg GAE.g^{-1} D.W.) (Olsson *et al.,* 2005). According to our results, total phenolic contents of rose hips are higher than wild *Rosaceae* edible fruits. Indeed, Jablonska-Rys *et al.,* (2009) found a high content in *R. canina* (32.17 mg GAE.g^{-1} F.W.), whereas a lower content was observed in *Prunus spinosa* L. (4.02 mg GAE.g^{-1} F.W.), *Rubus caesius* (2.47 mg GAE.g^{-1} F.W.), *Sorbus aucuparia* L. (2.26 mg GAE.g^{-1} F.W.) and *Fragaria vesca* L. (1.65 mg GAE.g^{-1} F.W.).

According to Bravo (1998), the presence of polyphenols in plants was greatly influenced by genetic factors, environmental conditions, degree of ripeness, variety, etc.. Phenolic compounds, the secondary metabolites of plant, are needed in terms of normal growth and developmentas protection of the species against adverse factors which threaten its survival in unfavourable environment, such as drought, UV radiation, infections or physiclal damage (Asami *et al.,* 2003).

Indeed, the differences in the environment conditions between regions of collection explain the less amount of polyphenols in the two accessions of *R. rubiginosa* and *R. dumetorum* from Beja region which has been growing in the river bank, compared to the accessions from Kairouan region which have been grown in arid climate. In another way, Shahidi and Naczk (2004) mentioned that phenolic compounds protect the easily oxidizable food compounds and inhibit the oxidation of vitamin C, carotenoids and unsatured fatty acids. We can highlight the *R. pomifera* from Kairouan region presenting the highest amount of polyphenols, ascorbic acids and carotenoids.

Analysis of the Relationship between Pomological and Chemical Parameters

The table 4 shows the highest positive correlation between Rh.Wi and Rh.W. (R^2 = 90%), Rh.Wi and Fl.F.W. (R^2= 88%), and between Rh.W. and F.Fl.W. (R^2 =96%). The highest negative correlation was reported between Fl/Rh and A.Nb (R^2 = -71%). For the nutrional value, only the positive correlation was highlighted between the contents of ascorbic acid (As.A) and of total polyphenols (T.Po) (R^2= 59%).

Principal Component Analysis

To identify whether the morphological and chemical parameters may be useful in reflecting the dissimilarity or the group of species and to characterize each one of them, the 14 morphological and chemical parameters related to rose hips listed in table 1 were assessed for the PCA. The horizontal and vertical axes of the PCA explained 39.42 and 21.63% of the total variance (Figure 1). Rose hip width (Rh.Wi), rose hip weight (Rh.W.), flesh fresh weight (Fl.F.W.), rose hip height (R.H), moister content (Mo), achene number (A.Nb) and rose hip aroma (Rh.A) were highly and positively correlated with PC1; while the flesh rose hip ratio was negatively correlated with this axis. Moreover, caretenoids content (Car.) was the value with the largest contribution on the positive plan of PC2, while achene weight (AW.) was the parameter with the largest contribution in the negative plan of this axis. Other parameters studied were moderately coorrelated with axes 1 and 2. The PCA identified 2 groups. The two species *R. pomifera* Kairouan region and *R. rubiginosa* Kairouan region with a dark red colored, and good aroma, clearly stand out forming a separate group A in the PCA. Those two species were correlated with most of the morphometric parameters for rose hips; weight (Rh.W.), width (Rh.Wi), high (Rh.H), a flesh fresh weight (Fl.F.W.), with a high number of achenes (A.Nb) and high moisture (Mo). Between those two species, *R. pomifera* Kairouan region was different from *R. rubiginosa* Kairouan region by its highest contents in Car., As.A, T.po, but *R. rubiginosa* Kairouan region by its highest achene weight (A.W.).

TABLE 3 TOTAL POLYPHENOL, ASCOBIC ACID AND CAROTENOID CONTENT IN ROSE HIPS FROM SIX *ROSA* ACCESSION

Species	Total contents		
	Polyphenol (mg GAE.g^{-1} D.W.)	Ascorbic Acid (mg/100 g F.W.)	Carotenoid (µg.g^{-1} F.W.)
R. pomifera Kairouan	*69.6±2.1c	737.8±10.6e	667.5±9.7e
R. rubiginosa Kairouan	33.0±1.1b	384.0±11.9a	373.3±6.9b
R. rubiginosa Beja	25.2±3.0a	545.0±13.9d	608.8±7.8d
R. dumetorum Beja	25.4±2.3a	433.8±7.8b	590.9±3.7d
R. dumetorum Siliana	37.0±1.3b	372.4±4.7a	446.9±4.9c
R. canina Zaghouan	34.6±1.1b	468.3±3.8c	206.4±4.0a

* Means ±SD, n=3. In the Same Column, Values with Different Letters are Significantly Different at $p < 0.05$

TABLE 4 MATRIX CORRELATION OF POMOLOGICAL AND CHEMICAL STUDIED PARAMETERS (TOTAL POLYPHENOL, ASCORBIC ACID, CAROTENOID CONTENT) FOR ROSE HIPS FROM SIX *ROSA* ACCESSIONS

	Rh.H	Rh.Wi	Rh.W.	Fl.F.W.	Fl./Rh	Fl.D.W.	Mo	A.Nb	A.W.	T.Po	As.A	Car	Rh.C	Rh.A
Rh.H	1													
Rh.Wi	0.33	1												
Rh.W.	0.61	0.90	1											
Fl.F.W.	0.62	0.88	0.96	1										
Fl./Rh	-0.20	-0.46	-0.52	-0.29	1									
Fl.D.W.	0.45	0.53	0.61	0.68	-0.01	1								
Mo	0.39	0.62	0.63	0.59	-0.42	-0.10	1							
A.Nb	0.48	0.55	0.62	0.49	-0.71	0.23	0.45	1						
A.W.	-0.11	0.40	0.32	0.37	0.02	0.29	0.13	-0.23	1					
T.po	0.36	0.01	0.15	0.10	-0.23	0.08	0.08	0.39	-0.29	1				
As.A	0.21	-0.01	0.06	-0.01	-0.32	0.04	0.00	0.40	-0.19	0.59	1			
Car.	0.12	-0.02	-0.01	-0.11	-0.32	-0.26	0.17	0.53	-0.56	0.18	0.51	1		
Rh.C	0.08	-0.23	-0.20	-0.21	0.05	-0.40	0.11	0.14	-0.65	-0.13	-0.27	0.51	1	
Rh.A	0.48	0.57	0.69	0.63	-0.48	0.21	0.59	0.57	0.15	0.56	0.37	0.16	-0.17	1

* For Abbreviation See Table 1

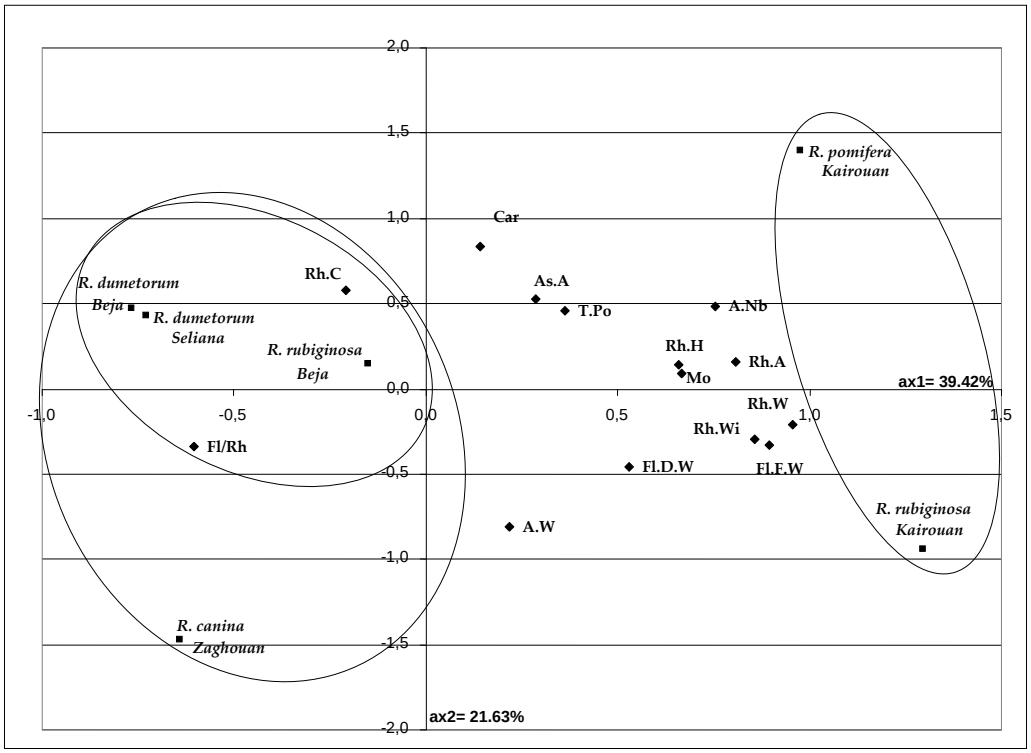

FIG. 1 PRINCIPAL COMPONENT ANALYSIS OF POMOLOGICAL PARAMETERS AND NUTRITIONAL VALUES OF ROSE HIPS FROM SIX *Rosa* ACCESSIONS. ROSE GENETYPES (■), PARAMETERS (♦)

Group B with the 4 other accessions correlated with the proportion of flesh for rose hip (Fl/Rh), whose values were the highest.

Group B1 formed by 3 accessions; *R. dumetorum* Beja region, *R. dumetorum* Siliana region and *R. rubiginosa* Beja region correlated with carotenoid contents having high values, and slightly with A.Nb, Rh.C, As.A, T.Po, whose values were moderatly high. *R. dumetrum* has scarlet orange rose hip color but dark red for *R. rubiginosa*.

Group B2 formed with *R. canina* Zaghouan region was characterized by A.W. and Fl.D.W.

Accessions were grouped on the base of their pomological parameters related to species, nevertheless, the environmental variation between regions of collection influenced the distribution of *R. rubiginosa* species. Indeed, *R. rubiginosa* from Beja region distanced *R. rubiginosa* from Kairouan region which is an arid site. Certainly, the environemental variations affected polyphenols and ascorbic acid content in rose hips, which can explain the separation of the two *R. rubiginosa* accessions.

Conclusion

Rose hip fruits gathered from the six *Rosa* accessions identified in the Tunisian Dorsal area revealed a great variability for the studied pomological and chemical parameters. *R. rubiginosa* Kairouan region had the heaviest rose hip while *R. canina* Zaghouan region had the highest proportion of flesh fruit ratio, the heaviest dry weight of flesh and the lowest achene number per fruit. The best source for active components was *R. pomifera* collected from Kairouan region (264 m altitude).

In conclusion, this study contributed to the characterization of rose germplasm native in the North and Centre of Tunisia. These results were of particular interest because they permited to identify rose genotypes producing rose hips with a potential to be exploited as a new food and a source of valuable natural compounds and their derivatives.

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